XIV. *On the Reversion and Restoration of the Silkworm* (Part II.); *with Distinctive Characters of Eighteen Species of Silk-producing* Bombycidæ. By Captain Thomas Hutton, F.G.S., of Mussooree. (Communicated by Mr. F. Moore.)

[Read December 5th, 1864.]

According to hitherto received notions all the silkworms now under domestication are mere varieties of one species, and are all placed together under the name of *Bombyx Mori;* and yet the difference in habits is alone sufficient to point out the existence of several totally distinct species.

This circumstance, when some time since noticed by myself in a letter to Mr. F. Moore of the India Museum, elicited the acknowledgment that Entomologists in Europe had long suspected the fact, but that they were without the means of working out all the necessary details, many of the supposed species not being under cultivation in Europe, while no one in India had deemed it worth while to enter into an investigation of the subject.

From the moment, however, in which I first recognized the absolute necessity of endeavouring to arrest the rapid strides which disease was making towards the extinction of the silkworm, I became aware, from actual inspection of the worms through all their changes, of the existence of several species, and I at once determined systematically to set to work for the purpose of extricating each from the dark labyrinth of error and confusion in which it had become involved.

Any one at all conversant with the *Bombycidæ* must be aware of the fact that, for the most part, the species will, in the northern and colder districts of their respective countries, be either strictly annuals, or at the most double-brooded, while those species which yield several crops of silk during the year, indicate thereby that they were originally imported into the localities where they are now domesticated, from the warm and more prolific lowland regions of the South. A rapid succession of crops, whether of vegetables or of silk, such as we witness among what are in Bengal termed "monthly worms," is obtainable only, whether naturally or artificially, in a mild climate favourable to the rapid growth of vegetation. To the preservation of such species, when in a state

of natural freedom, the healthy condition of the mulberry leaf until the commencement of the winter months is indispensable, and such a condition of things is obtainable only in a warm and probably humid climate.

At Mussooree in the North-Western Himalaya, nature herself speaks forcibly in support of this view when she presents for our consideration *twelve* wild species of the *Bombycidæ*, eleven of which are here strictly annuals, and one only is double-brooded, though some of these in warmer parts of India are found, even in the wild state, to yield two and even three broods.

Meditating on this fact, it occurred to me that if this could be relied upon as a distinguishing feature, the annual domestic worms would doubtless, on investigation, be found to be specifically distinct from the so-called "monthly worms," and the result has proved the correctness of this view, the Cashmere and Bokhara Annual being not only distinct from the Bengal Annual (*Boropooloo*), but both are distinct from the "*Nistry*," the "*Dasee*," and the small Chinese species *Cheena*, which are distinguished as monthly worms. Were they not specifically distinct, why do not the annuals when cultivated in Bengal become monthly, like the others? or, again, why do not the monthlies become annuals in the North? By their not undergoing these changes we are furnished with proof that it is not a change of climate which makes the alteration, but that nature has stamped them with distinctive characters and habits.

We have all read or heard of complaints in regard to the uncertain quality of the silk sent as that of *Bombyx Mori* to Europe from Bengal, and that it is on that account held in less estimation than silks from other countries. This variation in quality arises from the cultivation of these several distinct species under the name of *B. Mori*, precisely as all Eria silks were supposed to be derived from *Attacus Cynthia*. These worms being of different sizes and always much smaller than the larvæ of *B. Mori* (which species by the way is not cultivated at all in Bengal), must necessarily produce a silken fibre of far greater fineness than it; from which it results that not only is the reeled silk much finer than that of the true *B. Mori*, but each Bengal worm differs from the other in the thickness of its fibre, and as all goes home nominally as the produce of the same worm, no wonder that an outcry is raised about the uncertain thickness of the fibre.

This discovery of several distinct species confounded under the name of *B. Mori*, although admitted by competent judges in Europe, has in India been sneered at, and the differences percep-

tible in the size, colour, markings and habits of the worms, and the form and texture of the cocoons, have been attributed to the effects of climate only. Climate, however, has no such influence, since we find each species, in whatever climate cultivated, preserving the very same characteristics. If the differences at present perceptible were in reality merely the effects of climate and of peculiar treatment, we might surely expect that when a change of climate and treatment was experienced some marked and decided change would soon be perceptible in the insects likewise; but this is not the case, each retaining at Mussooree, in Oudh, and elsewhere in the Northern Provinces, the very same characteristics as when in the damp warm plains of Bengal. The characters, in fact, are constant, no matter where the insects may be.

Characters, whether of form, colour or habits, if permanent and unchangeable, are to all intents and purposes specific characters, and even Mr. Darwin admits that when one of his supposed varieties attains to a certain degree of stability, it assumes, *pro tem.*, the value and importance of a species until variation again commences at some after period among the offspring.

Under any circumstances, therefore, these insects, whatever they may originally have been, having now severally attained to permanency of characters, have become true species, and as such must be accepted and described.

Genus Bombyx, Schranck.

The genus *Bombyx* appears naturally to divide itself into two well-defined sections or sub-divisions, the first comprising all the domesticated Chinese species of which the larvæ have hitherto been known to cultivators and men of science as being of a pale creamy-white colour, and furnished only with one fleshy or semi-horny sharp-pointed spine, springing from the dorsal centre of the penultimate segment; the other containing the wild and uncultivated species, whose larvæ are not only richly variegated with a number of bright colours intimately mixed together, such as ashy-grey, livid-green, yellow, rufous, ferruginous and black, but are likewise furnished with from four to six longitudinally-disposed rows of fleshy or semi-horny spines, all curving backwards, besides one long one on the penultimate segment, placed between the two dorsal rows and pointing in the opposite direction.

Of the insects contained in this last section, one feeds on the wild indigenous mulberry tree of the North-Western Himalaya, and yields a first-rate silk, which, however, cannot be turned to

much account, as the worm is too intractable to submit to domestication, and can only be reared upon the trees in the open air, which of course renders the crop precarious, through the incessant attacks of birds and insects. This species was discovered by myself at Simla in 1837, but, owing to illness and the subsequent breaking out of the Afghan war, was not sent to Europe until 1842, when the moth was figured by Mr. Westwood in "The Cabinet of Oriental Entomology," under the name of *Bombyx Huttoni*.

A second species occurs sparingly in Bengal, in the neighbourhood of Calcutta, where it feeds on the leaves of the *Artocarpus lacoocha*, and to which I have assigned the name of *Bombyx Bengalensis*.

At Singapore, or in its neighbourhood, is a third species, called by Mr. Walker *Bombyx subnotata*, though nothing more than its existence appears to be known.

A fourth species is found in Assam, where it feeds on the leaves of the *Ficus religiosa* or Peepul tree, and is distinguished as the *Bombyx religiosæ* of Helfer.

And lastly, so far as continental India is concerned, the *Bombyx lugubris* of Drury is said to occur at Madras, though the statement appears to require confirmation, and Mr. Moore even doubts its being a *Bombyx* at all.

These two sections of the genus *Bombyx* being remarkable for the presence in the one, and the absence in the other, of bright colours and rows of spines in the larvæ, led me to entertain a suspicion that the Chinese domesticated species are no longer in their original condition; and followiug up this idea by a series of experiments, I soon discovered that with respect to colouring, the *Bombyx Mori*, and one or two others, when partially reverted to a state of nature, show a great and marked approach in the distribution and arrangement of their colours to the wild species of India.

Besides the genus *Bombyx*, this group of the family contains the genera *Ocinara* of Walker, and *Trilocha* of Moore; of the former I have discovered two, if not three, new species, and I understand that others have been discovered in Bengal. In the larva state this genus, although showing alliance with *Bombyx*, appears likewise to approach the *Geometræ*, the caterpillar generally having, not only something of the manner of the latter, but possessing also several of those curious little excrescences which give a Geometer the appearance of a dry stick with withered buds. The larvæ of *Ocinara* spin a small neat cocoon resembling

that of some of the smaller *Bombyces*, but there is not silk enough to render them worth cultivating. The larva of one of my Mussooree species, unlike the others, is hairy.

Before proceeding further it may be well to observe that in France and Italy, where none but annuals can be cultivated, the same degree of uncertainty as to species appears to prevail; *four varieties* of *Bombyx Mori* are there distinguished from each other as follows:—

First. The small silkworm of three casts or moults.

Second. The large silkworm of four moults.

Third. The common white silkworm of four moults.

Fourth. The common yellowish silkworm of four moults.

The eggs of the first of these are said to weigh one-eleventh less than those of the common silkworm; that is to say, that while 39,168 of the latter weigh an ounce, it requires for the same weight 42,620 of the smaller one. The worms and cocoons are also said by Count Dandolo to be two-fifths smaller than those of the common sort. "The cocoons, also," he says, "are composed of finer and more beautiful silk, whence it would appear that the silk-drawing tubes are finer in these silkworms." The cocoons are better constructed, and afford in proportion, at equal weight, a greater quantity of silk. The worms, likewise, come to maturity four days earlier than the common sort. Six hundred cocoons weigh 1½ lbs. In the south of France, according to M. Boitard, this race is known as the Milanese worm, being common in Lombardy.

With regard to the second variety we are told that it is cultivated chiefly "dans le Frioul." The difference in the weight of the eggs between this and the common sort, or fourth variety, is given as one-fiftieth only, that is to say, 39,168 eggs of the latter go to the ounce against 37,440 of the former, which are thus the heavier. One hundred and fifty cocoons weigh a pound and a half, while 360 of the common sort make the same weight. This variety requires five or six days longer to bring it to maturity.

The third variety is said to have been imported from China by the inhabitants of the "*arrondissement d'Alais*," and is common both in France and Italy; it differs from the others in constantly producing white cocoons, the silk of which is said to be finer than that of the common sort.

The fourth variety, which appears to have been selected as the standard of comparison, is the commonest of all and is cultivated

generally in France and throughout Europe. The cocoon is a yellow of different degrees of intensity.

Now the question arises—Are these to be considered as merely local and climatal varieties of *B. Mori*, or can any of them be regarded as true and distinct species?

With regard to No. 1, it is said that although in Italy nine out of ten cocoons are white, yet that in France the majority are yellow. No stress, therefore, can be laid upon the colour of the silk as a specific character, but a valid mark of distinction would (if there is no mistake) appear to exist in the fact of the worm undergoing only three moults instead of four as in all the others.

That this worm, however, is not in a healthy state is clearly to be seen in the change produced on the colour of the silk by change of climate, the heat of Italy producing white, and the cooler and more natural temperature of France producing yellow cocoons. But if this worm be a mere variety of *B. Mori* induced by climate, Count Dandolo's remark that the greater fineness of the silk is attributable to greater fineness in the silk-drawing tubes, at once proclaims the unhealthiness and degeneracy of the worm, which has dwindled down from its natural size and is no longer able to yield a fibre of the original thickness. If then this is a mere climatal variety of *B. Mori*, the peculiarities in its moulting, and the changeable colour and fineness of the silk, can be attributed to nothing else than loss of size and constitution.

If climate has been the agent by which this variation has been brought about, how is it that the entire race of *B. Mori* has not been affected in a similar manner? Yet in Italy, in France and in other countries of Europe, *B. Mori* still continues not only to hold its ground side by side with this supposed variety, but is in spite of climate stated to be still the commonest of all.

An Indian sericulturist rising from the perusal of Reports on the Culture of Silk in various parts of the country, will find perhaps that no two of these agree in the length of time consumed between the hatching of the egg and the spinning of the cocoon. The explanation is, that the reports do not all apply to the same species, for at Madras and in Bengal proper, the true *B. Mori* is nowhere found, and it has only very recently been tried, and with no very encouraging success, in the North Western Provinces of Upper India. But the time that elapses between the hatching of the egg and the spinning of the cocoon will vary even in the same species, according to the temperature in which the worm has been reared, and likewise, in some measure, accord-

ing to the health of the insect. As a rule, the whole process will be more rapid in a high temperature than in a colder one, and it is to be observed that the longer the time consumed, the better in general will be the cocoon, for the simple reason that the worm has had ample time to come to maturity, whereas when the growth is forced and accelerated by high temperature, although the worm may grow to a goodly size, it will still have passed through its different stages so rapidly as materially to diminish the quantity of silk-gum, which it has not had time to secrete. The cocoon will, consequently, be less stuffed with silk than when, all other things being equal, a longer time has been consumed. Count Dandolo lays it down that thirty-two days elapse between the hatching of the egg and the formation of the cocoon, and he adds four days more for the completion of it, or thirty-six days in all. This likewise is the time given by M. Boitard as applicable to the worm in France. Dewhurst informs us that in England forty-six days are consumed. In China, according to published accounts, the time varies greatly, being from twenty-three to twenty-eight and sometimes forty days, with an additional seven days allowed for the cocoon, so that we have thirty, thirty-five and forty-seven days given as the time. Contrary to all experience also, it is said that *the shorter* the time consumed, *the more abundant* will be the crop of silk, twenty-three to twenty-five days producing twenty-five ounces of silk from one dram's weight of newly-hatched worms; twenty-eight days yielding only twenty ounces, and thirty to forty days producing no more than ten ounces. This is clearly an absurdity, for it shows that the longer the worm continues to secrete gum, the less silk will it produce. Dr. Anderson, as quoted by Dewhurst, says that in Madras twenty-two days only are required; while Mr. Cope of Umritsir gives twenty-eight to forty days, but whether for the Punjab or elsewhere is not stated. At Mussooree I have found the time consumed by *B. Mori* to run from forty-six to forty-eight days. At Lucknow in Oudh, Dr. Bonavia gives "about forty-six days" for *B. Mori*, and seventeen for the small Chinese monthly worm in the month of June, and fifty-one days in November.

It is evident that these statements cannot all apply to the same species. In France and in Italy, in England, Oudh, the Punjab and Mussooree, the reference is to the annual *Bombyx Mori*, known in Europe as "The common silk worm of four moults," and in India as the Cashmere or Bokhara worm.

The time, therefore, consumed by *B. Mori* in France and Italy is about thirty-six days; in England, Oudh, Punjab and Mussooree about forty-six days.

Mr. Cope, in a Lecture on Silk delivered at Lahore, gives (as before mentioned) from twenty-eight to forty days as the time consumed. If *B. Mori* spins its cocoon in twenty-eight days from the time of hatching, a stronger proof of the total unfitness of the Punjab climate for the culture of that species could not be furnished. The fact, however, is that the time laid down in the lecture cannot satisfactorily be applied to any species in particular, but evidently includes more than one.

The Chinese account likewise would appear to have reference to more than one species, while in Madras, the species referred to by Dr. Anderson was in all probability one of the three monthly worms, because the true *B. Mori* is nowhere cultivated below the North Western Provinces.

The true time consumed from the hatching of the worm to the completion of the cocoon would, consequently, appear to range from thirty-six to forty-six days, and the more rapid progress made in Europe is probably to be attributed to the fact of the worms being shut up in rooms with a temperature of 68° to 77°, which is altered after every change of skin. Thus, Dewhurst says, "75° is the degree of heat they should be kept in until the first casting or moulting; between 73° and 75° until the second moulting; between 71° and 73° until the third; and lastly, between 68° and 71° until the fourth moulting."

From this statement we perceive that, according to this writer, the temperature should be reduced as the worm advances to maturity, a procedure which is diametrically the reverse of that pursued by nature.

According to the same authority "it has been proved by a series of experiments that in France 68° is the heat most suitable to silkworms; some cultivators have raised it as high as 77° with good success, while M. Boisseur de Sauvages has even gone as high as 100°."

At Mussooree I have always reared the worms in an open room, so that, as the external temperature varied, that of the interior varied likewise, and the air was always fresh and natural. The eggs hatched spontaneously in a mean temperature of 64°, and the thermometer never rose beyond 68° up to the time of spinning the cocoon. During the same time the daily mean of the external temperature ranged from 47° to 66°, so that the French view of the matter is thus proved to be the most correct. I have shown, moreover, (*ante*, p. 152,) that I found great difficulty in checking the hatching of the eggs even in a temperature of 53°, and only did so at last by placing them out all night in the frosty air of December, at an elevation of 5,400 feet.

The small Chinese monthly worm (*B. Sinensis*) required in the month of June, in the warm climate of Oudh, no more than seventeen days from the hatching of the egg till the formation of the cocoon, while, in the cooler temperature of November, fifty-one days were consumed. At Mussooree, the same species, hatched on the 26th of June, spun the cocoons in twenty-eight days; while the *Boro-pooloo* (*B. textor*), which was hatched on the 14th of March, began to spin on the 28th of April, consuming thus forty-six days, or the same as *B. Mori*.

This circumstance, together with the similarity in the marking, and the occurrence of black worms in the brood, has led Dr. Bonavia somewhat hastily to conclude that the Cashmere worm and the Boro-pooloo are one and the same species, an error into which he could scarcely have fallen had he given due weight to the fact that not only is the worm a full inch shorter than that of the Cashmere worm, but the size, colour and texture of the cocoons are all totally distinct, and no naturalist could ever confound the one with the other. These differences, moreover, are permanent, even where the species are cultivated together, and the occurrence of black worms merely shows that the Boro-pooloo, like *B. Mori*, has completely lost its constitution. Black worms are also occasionally found in the broods of the *Nistry* (*B. Cræsi*), which is undoubtedly distinct.

If, then, we unite all the species under the one name of *Bombyx Mori*, we shall find that the time consumed from the hatching of the egg to the spinning of the cocoon will vary in the same climate from seventeen to forty-six days, a circumstance which is alone sufficient to point out the incorrectness of such an arrangement: while if we more reasonably insist upon there being several distinct species now confounded together, the difficulty at once vanishes, and the difference at present observable is satisfactorily accounted for.

I shall, therefore, now proceed to unfold my views on this subject, and show, from the peculiarities observable in each species, upon what grounds I insist upon specific distinction.

1. Bombyx Mori, Linn.

Synonymes.

Phalæna Bombyx Mori, Linn. S. N. 1, 2, p. 817 (1767); Amœn. Acad. iv. p. 563; Faun. Suec. p. 832; Aldrov. Ins. p. 280; Albin. Ins. pl. 12, f. 16; Reaum. Ins. ii. p. 5, f. 2; Rœsel. Ins. iii. pl. 78.

Bombyx Mori . . Fab. Spec. Ins. ii. p. 180; Mant. Ins. ii. p. 114; Ent. Syst. iii. 1, p. 431; God. Lep. de France, iv. p. 153, pl. 14, f. 3, 4; Walker, List Lep. Het. Brit. Mus. pt. 6, p. 1505; Moore, Cat. Lep. Mus. Ind. House, ii. p. 374.

Sericaria Mori . . Blanchard, Gay, Hist. de Chile, Zool. vii. p. 55.

Lasiocampa Mori . Schranck.

Lasiocampe du Murier Boitard, p. 148.

The common domesticated Chinese silkworm of Europe.

Habitat.—Originally the northern mountainous provinces of China, especially that of Tche-kiang; now domesticated in China generally, in Cashmere, Afghanistan, Bokhara, Persia, Syria, France, Italy, Spain, Sweden, Russia, &c., and recently introduced into Oudh and the Punjab.

The species termed by the late Dr. Royle "*Pat major*" refers not to this, but to the Bengal Annual known as *Boro-pooloo*, while that mentioned by Dr. Helfer in the J. A. S. B. vi. p. 41, as cited in Mr. F. Moore's "*Synopsis*," probably refers to one of the monthly worms which have hitherto passed under the name of *B. Mori*, a species which, at the time when the Doctor wrote, was confined to Cashmere, and was certainly not cultivated in any part of Bengal or the Lowland Provinces.

The word "*Pat*" appears to be used as a generic term.

Larva.—Originally from the Northern parts of China, the worm of *Bombyx Mori* is now extensively cultivated for its silk, in various countries both of Asia and of Europe, and everywhere thrives best where the temperature is moderate. It is the largest and the strongest of the domesticated species, and is an annual, producing naturally but one crop of silk in the year, although in certain temperatures it is possible to make it produce a second crop.

When first excluded from the egg the young caterpillar is hairy and of a dark-brown colour, the edge of the anterior segment being ashy white; the head and prolegs are shining jet black.

In the course of four or five days the five anterior segments become slightly swollen, exhibiting a mottled appearance of brown dots and small patches on a livid ashy ground, and previous to the first moult these segments become altogether livid ashy, while the others are of a pale brown; there is one short tubercle or spine on the middle line of the penultimate segment, and the hairy ap-

pearance of the young worms is owing to short tufts of hairs springing from rows of rudimentary tubercles as in the wild and uncultivated kinds. These, however, all disappear, with the exception of the anal spine, after the first moult.

In the second stage, the four anterior segments are of an ashy white, the dorsal portion of the second and third segments being swollen and wrinkled; the remaining segments are pale brindled, or mottled grey, with a slightly mealy aspect; a short, blunt, somewhat flat-sided, semi-horny tubercle on the dorsal centre of the penultimate segment, and having generally a faint tinge of orange; on the fifth segment are two faint semilunar brown marks like inverted commas, and on the eighth segment are two small round spots of brown; head and prolegs black.

After the second moult the insect becomes altogether of an ashy or creamy whiteness, the second and third segments still more swollen and wrinkled; on the front of the second segment is a thin longitudinally disposed dark line with generally a small dark spot on each side of it; two dark semilunar marks on the back of the fifth segment, and the dark spots on the eighth slightly raised; anal horn pointed and somewhat suddenly attenuated, with an inclination to point backwards; head mealy grey-brown, and small as compared with the rapidly increasing size of the body.

In the two following stages there is usually no alteration, except that the length and thickness of the worm rapidly increase, and that the markings become more conspicuous, that on the fifth segment often assuming the form of a crown. The feet are fringed with minute cilia. The entire body is without hairs and quite smooth; the stigmata or breathing apertures along the sides are small, round and dark, and in the last stage of growth the two dots on the front of the second segment increase in size and are partially rufous. The length of a full grown worm, cultivated at Mussooree, is from 3 to 3¼ inches.

Such is the appearance of the worm as now cultivated (Pl. XIX. fig. 8), but in almost every batch of worms there will be seen after the first moult has occurred, some dark-coloured ones which at the first glance appear to be a distinct species. By the French these worms are regarded as a mere evanescent variety and are distinguished as "*vers tigrés*" and "*vers zébrés*;" so far, however, are they from being a mere passing variety that they are actually types of the original species, and merely require to be treated according to the established rules of breeding in order to render them permanent and healthy.

The Black Worm. (Pl. XIX. fig. 7.)—When first hatched the caterpillars are in all respects similar to those of the pale variety, and it is not until after the first, and sometimes second, moult has taken place that any difference is perceptible; then, however, instead of having the four anterior segments of a creamy-white, the whole body is of a dark-brindled or mottled-grey colour, with the exception of an ashy band or broad stripe, which, crossing in front of the anterior segment, runs round on each side as far back as the middle of the fifth segment, widening up towards the back, but leaving a dark-brindled dorsal space between them; at a later stage, when the worm is near maturity, this ashy band becomes less clear and bright, and is often tinged faintly with clay colour, or even with a fleshy roseate hue; on the fifth segment the two dark lunules are well defined, and have an ashy patch between them; the dark spots on the eighth segment are sometimes wanting, as they are also in the white variety.

In the third and fourth stages the colouring generally becomes very dark, in some intensely so, and takes the form of a net or trellis-work spread over an ashy-grey ground. As the worm approaches the spinning time the colours again become fainter, and often assume a grey sandy-brown hue overlaid by the dark network. The anterior portion of the second segment rises somewhat abruptly, and from it, through the dorsal centre of the first, runs a narrow black longitudinal line, on each side of which, on the second segment, is a round black spot, perpendicularly divided by a pale orange line, causing the appearance, as it were, of two eyes.

Such is the appearance in the first year of the separation from the white worm; the differences in after years, of course, become more marked, though the general character is the same.

After two or three years of separation and restricted interbreeding the appearance, especially in the middle stages, is very dark indeed, and the whole insect looks as if overlaid by a well-distended net, the meshes of which are open and well defined; it is, indeed, this well-defined marking, together with the ashy lateral band along the anterior segments, which makes the species approximate to the wild races, the lateral band more especially being a characteristic of the wild worms.

Progress of the Experiment.—In the previous part of this paper (*ante*, pp. 149—153) I have shown the result of my experiments up to the end of 1863. I now proceed to show the condition of

the worm in the spring of 1864, when the eggs deposited in the spring and autumn of the past year began to hatch on the 21st of March in a temperature of 65°.

First, then, with regard to the white worms, it was observed that, although for two years running the black worms had been all weeded out from them, yet the per-centage of dark worms was far greater than before; showing thus, according to the experience of cultivators, a great accession of strength and health; great numbers of the eggs likewise adhered firmly to the paper on which they were deposited, instead of being loosely scattered as heretofore, but the white worms have never yet produced a second crop. This variety, though far from being in the best health, showed no increase of degeneracy over previous years.

With regard to the black worms, they hatched on the same day with the others, although some had been deposited in spring and others in the autumn of 1863. All were decidedly unhealthy, although those from the autumn batch were far less so than those of spring, the latter being so terribly affected with jaundice, and with some disease that turned the worm dull green, that I was compelled to throw the whole away. The worms from the autumnal batch went on well enough and spun good cocoons, the moths from which deposited a goodly number of eggs in the end of May, and these began to hatch for a second crop in September, 1864. They are apparently healthy, and from a few of their eggs I shall carry on an experiment for amusement, but I feel fully persuaded now, after several years of observation, that the constitution of the worm has been so thoroughly undermined that, although we may be able to restore it to its natural appearance, it will never be able thoroughly to shake off the various diseases to which it has so long been subject. The only way open to the sericulturist is, therefore, to re-seek in the original habitat in China for the wild worms in their natural state of freedom on the trees, and should any of these be procurable, then may the entire stock in Europe be gradually renewed, and the present impending ruin be averted.

Dr. Bonavia of Lucknow, the active and enterprising secretary to the Agri-Horticultural Society of that province, having in the spring of 1864 furnished me with a few eggs obtained from Marseilles, I proceeded to ascertain whether they differed from the Cashmere worm or not.

These began to hatch, in a temperature of 67°, on the 4th of April, when the Cashmere worms were already fifteen days old; in the batch were a few of the dark coloured ones, but none,

whether dark or white, appeared to be healthy; still they were not worse than their congeners, and eventually spun better cocoons, being, although not so large, much more stuffed with silk. Between these worms and those from Cashmere stock there is not a shade of difference, both being *B. Mori*.

Imago.—In the moth the ground colour of the wings is a dull ashy white; sometimes they are entirely ashy, without any lines or other markings, while some have only two short parallel lines on the fore-wings near the centre of the costal margin. In others there are lines as below described, but no colours. These are from the white worm as now cultivated.

The appearance of moths produced from black worms approximates more to the wild *B. Huttoni*, both in colour and in markings.

In these the ground of the wings is still ashy, and the male, as usual, is smaller than the female, having the shaft of the antennæ white, with dusky black plumes; eyes black; body and ground of wings ashy-white, suffused with a pale brown tinge; near the basal angle of the fore-wing are two parallel lunate lines, the horns of which point inwards and rest upon the anterior and posterior margins; between these lines darkish brown, in some instances blending them into a brown band, in others the lines are clear and distinct; about the middle of the costal margin, at a little distance within the wing, are two very short parallel lines slightly curved in the opposite direction to the basal ones; these, however, are sometimes absent; across the wing, from the anterior to the posterior margin, are two partially parallel submarginal lines at a little distance apart, the inner one being a slight curve and the outer one taking a bend or lunate sweep near the exterior and posterior angle; these lines are sometimes distinct and clear on the ashy ground, at others they are blended into a dark-brown band by the deep suffusion of the space between them. Fore-wing strongly falcate in both sexes; the hind-wing is rounded on the exterior margin; abdominal margin folded down as in *Ocinara*, with one blackish spot about the middle; from the anterior to the abdominal margin are two subparallel lines through the disc of the wing, curving parallel to the outer margin, sometimes distinct, at others blended by the suffusion of the inclosed space with brown. The female is much the same, but there is in both sexes the greatest variety in the markings, which is, I think, a clear indication that the insect is not in a natural condition or sound state of health. The under-side dull ashy, with the dark lines and bands visible, as above. The male often exhibits ashy wings, with brown bands,

and the body dark grey. Expanse of wings in the female 2 inches; in the male $1\frac{3}{4}$ inches, although the size varies as much as the colouring.

2. Bombyx textor, Hutton.

Syn. *Bombyx Mori* of Indian sericulturists.

The *Boro-pooloo* of Bengal; "*Pat major*" of Royle.

This species, hitherto confounded with the preceding, is said to have been introduced from China, where it is still cultivated, under the name of the *white cocoon*, but the time of its introduction into India appears to have been forgotten.

In Bengal, as well as in its native country, it is an annual, hatching early in the spring, usually in January, yielding generally pure white cocoons, far inferior in size to those of *B. Mori*, and altogether of a different shape, character and texture, having an inclination to become pointed at each end, and with the silk not closely interwoven, but externally somewhat flossy and loose, whereas the cocoons of *B. Mori* are closely woven, compact, hard and smooth, ovate in shape, and four or five times larger; some that I have received from France being little inferior in size to those of the Tussur moth (*Antheræa Paphia*).

The worm, when mature, bears a strong resemblance to that of the preceding species, but is much smaller both in length and thickness, and, as a strong mark of distinction, it may be observed that it preserves all its characteristics unchanged, even when cultivated in the same climate and in the same manner as *B. Mori*, neither of the species exhibiting the slightest indication of adopting the peculiarities of the other.

In Dr. Bonavia's Report on Sericulture in Oudh for 1864, he remarks of *B. textor*,—"I cannot find any reason to believe that this worm belongs to a different stock from the Cashmere and Bokhara worms;" others have said the same thing, which only proves to me that they have never looked beyond the worm itself, since had they done so they might have found, as I have done, abundant proofs of specific distinctness.

The same gentleman proceeds to inform us that—"Captain Hutton favoured me with a small quantity of eggs of his selected dark-coloured worms. According to his views the dark-coloured variety approaches more to the wild kind, and therefore has more healthy blood in it than the white variety, which he considers as a degeneration of the original worm. It is strange though that the 'Boro-pooloo,' which has been reared in Bengal for a long

time, contains a large number of the dark variety. One would be inclined to think that, considering the bad mode of rearing and the climate of Bengal, it would have degenerated into the white variety by this time, according to Captain Hutton's theory."

The writer, however, shows, by the admission that "a large number of the dark variety" occurs amongst the Boro-pooloo worms, that "Captain Hutton's theory" actually does hold good. Just as with the originally dark-coloured worms of *B. Mori*, so also the originally dark-coloured worms of *B. textor* "have degerated into the white variey." The occurrence of these dark worms, as I have pointed out (*ante*, pp. 148 *et seq.*), is due to an effort on the part of nature to return to the original stock, from the sickly degenerated state into which the species have fallen.

Again we are told that, "the selected dark-coloured worm of Mussooree did very well, but I could not detect any difference between the cocoons of these and those of the white Cashmere ones. I selected many of the black ones of the Cashmere, Bokhara and 'Boro-pooloo,' and kept them separate, but did not find that they produced better cocoons than the rest, and they all had one disadvantage, that is, on account of their colour, it was not easy to discover when they were ready to spin."

Be it observed, however, that in furnishing these dark-coloured worms, I did not guarantee the same results in Oudh as are obtainable in the European climate of Mussooree. I should not have been at all surprised to hear, considering the heat of Oudh and the inexperience of the conductor of the experiments, that every worm had returned to a state of sickly whiteness. As to the difficulty of discovering when they were ready to spin, this could only have occurred to an unpractised eye, since there is always a semi-transparent yellowish waxy hue about a mature worm that is quite unmistakeable to an experienced eye.

According to Mr. C. Blechynden and Mr. Bashford, this species is the one that in Bengal is recognized as "*The Italian Stock*;" in which case it would appear to be identical with that which in France is termed "*The Milanese worm*," though if such be the case, how are we to account for its only undergoing three moults in France and Italy, while in India it invariably has four, like all the others? I incline very strongly to the belief that this alleged peculiarity is altogether fabulous.

In Bengal, according to Mr. C. Blechynden and others, the worm is also sometimes dark coloured like those of *B. Mori*, thus showing clearly that it is not in its original healthy state; the

worms attain a length varying from 2 to 2½ inches, as is the case also at Mussooree.

As regards the colour of the silk, nothing could more strongly support my view that white is a sign of weakness and degeneracy. In Italy, we are informed, there are generally nine white cocoons in every ten,—but when cultivated in France bright golden yellow is the predominant colour; this is undoubtedly an effect of climate, showing that the warmth of Italy is less adapted to the health of the insect than the cooler temperature of France, which in some districts is nearly the same as that of Mussooree, where precisely similar results have been observed. The eggs of this species, hatched in March, 1864, from the deposit of May, 1863, gave seventy-eight black to thirty-one white worms, in a batch of 109, whereas in 1863 eggs procured from Bengal produced white worms without a single exception. The cocoons spun in 1863 by the Bengal worms were all white, with the exception of about half a dozen, whereas in 1864 there was not one white cocoon, all being of a bright golden yellow. In China, as in Bengal, the usual colour is white, with an exceptional sprinkling of yellow cocoons. Here we have the effect of climate distinctly marked, and showing that while a high temperature produces both white worms and white silk, a temperate climate, by imparting strength, produces dark worms and yellow cocoons.

The worm which in France gives permanently a white cocoon, and which was imported from China into the "*arrondissement d'Alais*," would appear to be distinct both from *B. textor* and the other two varieties; so that if No. 1, or the Milanese worm, be our *Boro-pooloo*, as I suspect is the case, and Nos. 2 and 4 are true *B. Mori*, then No. 3, with the permanent white silk, is in all probability a distinct species.

The changes in the appearance of the caterpillars of *B. textor* are precisely similar to those observable in *B. Mori*, and need not be repeated; when first hatched, the worms of *B. textor* are rather black than brown, and although in the after stages there is in the colouring and marking of the two species no really tangible and well-defined distinction, yet at the same time there is to the eye a perceptible difference in the shade of colouring, which is darker, more *prononcé*, more equally diffused, and more of a neutral tint in *B. textor* than in *B. Mori*; the latter, besides attaining to a far larger size and forming a totally different cocoon, has the dark parts less purplish and not so generally diffused. These remarks, however, pertain to the black worms only; the white ones differ in no respect except in size.

Having now disposed of the Annuals, we have to consider the question of distinction with regard to what are commonly termed "Monthly worms."

3. Bombyx Crœsi, Hutton.

Syn. *Bombyx Mori*, var., of Indian sericulturists.
The "*Nistry*," and "*Madrassee*" worm of Bengal.

This is a much smaller species than either of the preceding, yielding seven or eight crops of silk in the year; the cocoon is small, of a beautiful bright yellow colour, and of a somewhat loose and flossy texture. It is said to thrive best in the summer months from June to October, and at other times is only kept up to preserve the stock. In hot weather it goes through all its changes from the egg to the cocoon in twenty-five days, but in the colder months it occupies thirty-five days. The worm is from $1\frac{1}{2}$ to 2 inches long, and is of a clear silvery or pearly hue, having a moist dewy appearance. The anal spine is short and truncated, and the dark lunar marks, which are so conspicuous on the fifth and eighth segments of the two annuals, are in this species wholly wanting. It is said never to yield white cocoons, but that dark worms occasionally appear in the brood. I suspect this to be the "*Pat minor*" of Helfer and Royle.

4. Bombyx fortunatus, Hutton.

Syn. *Bombyx Mori*, var., of Indian sericulturists.
The "*Dasee*" worm of Bengal. (Pl. XIX. fig. 3.)

This is the smallest species of the whole, and is said to be hardy, but the yield of silk is uncertain; there are no dark worms among them, and they thrive best in the cold season, occupying at that time from the egg to the cocoon about forty days, but in hot weather only thirty-three days.

The silk is of a golden yellow, and the cocoon small; it resembles that of *B. Crœsi* in form and texture. When near maturity there is a very marked and perceptible difference between this species and all the others, the worm being of a bluish leaden-grey throughout; the ocelli or lunate marks on the fifth and eighth segments are wanting, as in the last; the anterior segments are slightly intumescent and wrinkled; a short pale spine on the penultimate segment. The eggs are small, and pale straw colour, remaining so until within a day or two of hatching, when they become leaden-grey.

5. Bombyx Arracanensis, Hutton.

Syn. *Bombyx Mori*, var., of Indian sericulturists.
The *Arracan* worm.

When first hatched, the Arracan worm is very small; of a pale sandy-brown colour, and hairy, like all the others; anterior edge of the first segment whitish, or livid ash; head black.

I succeeded only once, many years ago, in obtaining a few eggs of this species, through the kindness of Mr. Blechynden, secretary to the Agri-Horticultural Society of India, a gentleman whom I have uniformly found ready to assist in every useful inquiry. The worms produced from these eggs were very feeble, and, refusing to feed, were all dead by the evening.

The cocoon is said to be larger than those of the Bengal monthly worms, and the silk strong and good.

The worm is supposed to have been introduced from Burmah.

6. Bombyx Sinensis, Hutton.

Syn. *Bombyx Mori*, var., of Indian sericulturists.
The small Chinese monthly worm.
"Sina" and "Cheena" of the Bengalis.

The worm of this prolific species is considerably smaller than that of *B. textor*, and the cocoon partakes much of the same characters, being sometimes white and sometimes bright yellow, with occasional cocoons of a beautiful faint greenish-white. The markings of the mature insect are very different from those of the *Boro-pooloo*, and from all the others.

Eggs received from Bengal began to hatch on the 26th of June; head and pro-legs jet black and shining: the body hairy and pale brown, with minute anal horn.

On the 30th of June these worms moulted, the head and pro-legs being black as at first; the four anterior segments pale ashy, the second and third gibbous and wrinkled; the remainder mottled ashy-grey; a short blunt conical spine on the penultimate segment. There are also two longitudinal dorsal rows of minute round black dots, four on each segment, and giving out minute hairs; on the fifth segment are two semi-lunar brown marks, the horns of which point inwards, as in *B. Mori*; the anal tubercle with a few short cilia at the summit, and behind this, on the anal segment, are two minute tubercles placed close together like the sights on a gun, and behind them again lower down, and on the anal shield or valve, are two others; stigmata black.

After the second moult, the appearance is much the same, the head and pro-legs being black; the four anterior segments ashy; remainder mottled iron-grey; stigmata black; lunules as before on fifth segment, and two small black dots on the front of the second segment.

On the 9th of July the third moult was completed, the head having changed to ashy-white; the body entirely ash-coloured; two small black dots in front of the second segment, and two on the posterior part of the third; two lunules or sickle-shaped dark marks on the fifth segment, composed of two narrow dark curves enclosing one of ash; on the eighth segment are two small brown circular spots; in other respects as before, and still very small; stigmata a black ring with white centre.

On the 15th July the fourth moult was completed, the worm being of a faint waxy colour with grey-brown head; the two dots on the front of the second segment now give place to a transverse bar with a dot at each end. Two dorsal and two lateral rows of small tubercular brown dots. The marks on the fifth and eighth segments as before, but darker and more conspicuous; stigmata a black ring with white centre. After the fourth moult the worm increases rapidly, and finally attains the length of $2\frac{3}{10}$ inches.

On the 22nd July they began to spin, and the cocoons were generally of a fine bright golden-yellow, although white cocoons were far from uncommon. The form and loose flossy texture of the cocoon is the same as that of the *Boro-pooloo*, but those of the latter are larger. In the spinning of the cocoon there was an immense waste of silk, arising, I suspect, from some unhealthiness, as the worms were restless and wandering, beginning a cocoon in one place, and then leaving it to seek a fresh spot, which was perhaps in turn abandoned, until sometimes all the silk was thus frittered away, and the worm either died or became a naked pupa.

On the 4th of August the moths began to issue from the cocoons, and coupled; they were very small and altogether ashy-white, without any markings on the wings.

The moths showed the presence of disease in having black inky spots upon the wings and beneath the skin of the abdomen at the junction of the segments; still they coupled freely and laid a plentiful supply of eggs, which were at first nearly white, but changed to pale yellow in the course of a few hours.

The coupling continued for about ten hours, when they voluntarily separated. The males appeared to be somewhat sluggish, and the females in most cases, after the first coupling, would not permit a second.

On the 16th of August the eggs, although still of a pale straw-colour, became somewhat dusky and exhibited the black head of the young caterpillar within the shell.

On the 17th these eggs had become grey and of good colour. On the 18th they all hatched in a swarm, and I found that, unlike *B. Mori*, which ceases to hatch about midday, these continued to come forth during the entire day and night, until all were excluded.

When first hatched they are about $\frac{1}{10}$ of an inch long; and after the first moult $\frac{3}{10}$ inch; after the second moult $\frac{5}{10}$ inch; after the third moult $1\frac{3}{10}$ inch; and at maturity just before spinning $2\frac{3}{10}$ inches.

I observed a curious fact with regard to some of these eggs that were laid on the 5th of August,—about 20 of them turned vinaceous on the 10th, while all the rest of the brood remained *in statu quo*. These coloured eggs were not scattered about among the others, but formed a small group by themselves. They did not hatch with the others, but remained in the same vinaceous state until the 3rd of October, by which time the others were again laying eggs. Yet I could perceive no difference in the worms afterwards, although there had been an interval of 30 days between the hatching of the two parties laid on the same day.

This species continued to yield crop after crop even up to the middle of December, when many of the cocoons remained dormant, while others yielded moths which laid eggs that remained unhatched, the weather being very cold and variable, and no leaves remaining on the mulberry trees. Here I think we have a clear proof that at least this monthly worm could never have inhabited a northern climate, but must by nature be entirely restricted to warm lowland regions in which mulberry leaves are procurable all the year round.

It appears from some remarks of Mr. C. Blechynden that it was to this species and not to the Nistry (*B. Crœsi*) that allusion was made in Young's Magazine of Agriculture, as quoted by Kirby and Spence, and the same gentleman observes that the name given to the species by the natives is "*Sina*" or Chinese. He remarks as follows:—"The worm mentioned by Kirby and Spence does exist and is known as '*The China worm*;' it goes through all its changes from egg to cocoon in twenty-two days; so it is nothing strange to have new progeny in a month. The period may be shortened by two or three days if the room occupied as a rearing-room is kept at a high temperature; it breeds all the year round, but in the cold weather is longer in going through its

mutations and does not thrive well. This might be obviated by keeping the room warm, but we should be thrown out by the want of leaves, the mulberry putting on its wintry garb of bare branches."

This information was kindly furnished from the Radnagore district, but it is equally applicable to all others in India, the time occupied from egg to cocoon varying always with the temperature in which the worm is reared, being, as with the other species, more rapid in a high than in a cold temperature, as witness Dr. Bonavia's experiments in Oudh, seventeen days in June and fifty-one in November.

Mr. Blechynden's remarks as to the worms thriving better in summer than in winter tend to support my opinion that the monthly worms belong naturally to the more genial temperature of the south, while the annuals only belong to the colder mountainous regions of the north. It is also said of this worm that "yellow cocoons will produce insects that give white silk, but that insects from white cocoons never produce yellow." Here then is a corroboration of my previous argument that white is a sign of degeneracy and weakened constitution.

From what has already been said, then, I think ample proof has been furnished of the existence of at least six species of domescated *Bombyces*, instead of one as heretofore supposed.

Before passing on to a consideration of the wild species I would say a word respecting the hatching of the eggs of *B. Mori* for a second crop: at Mussooree, where this was first observed, we have in effect what may be termed a double season, or two springs, so that when after the rainy season the temperature falls back to from 68° to 62°, the eggs will again begin to hatch. I have observed this both in *B. Mori* and *B. textor*, but I am inclined to think that it will only occur with worms in a transitional state, that is to say, before they have become acclimatised; and that as soon as this has been effected the irregular hatching may be expected to cease. For three years my worms of selected *B. Mori*, or the dark kind, have given a second crop; but the very attempt to cause them to revert may have had some effect in unsettling them, for the white variety I have never found to yield a second brood. With *B. textor* the same thing occurred, and for three or four years they continued to give an autumnal crop; this year, however (although *B. Mori* is now in September hatching in a temperature of 68°), the *Boro-pooloo* remains unhatched, although in previous years the hatching commenced about the 22nd of August, a full month earlier. I expect, therefore, that *B. Mori* will eventually likewise settle down again into an annual. That the hatching is in some

measure to be attributed to the alteration of climate seems proved by the fact that the *Boro-pooloo* removed from Bengal into Oudh began to hatch for a second crop in the month of April, but was checked by being placed in a colder temperature. (Dr. Bonavia's Report, 1864, p. 8.)

Of the moths of the different species I have said nothing because I do not consider any one of them to be in a natural state; at present, with the exception of size, the same description would apply nearly equally well to all of them; and it is to be observed, moreover, that, even taking each species separately, there will be found a very great variety among the moths, so that it would be next to impossible to decide as to which was to be regarded as a typical specimen. Pale ashy-white, with a brownish band running parallel with the exterior margin of the upper wings, is the usual appearance, although the band is often either partially or altogether absent. This uncertainty must be attributed to the unsettled condition of the insects, and will never cease until each is restored to something like its original vigour of constitution.

Wild indigenous Species of India.

Turning now to the wild species of Continental India, we are at once struck by the fact that, instead of being exclusively restricted in their diet to the mulberry leaf, as are the domesticated worms from China, one only of the four known species is found upon that tree, while two of the others are respectively restricted, it would appear, to the *Ficus religiosa* and *Artocarpus lacoocha*, the food of the fourth species being unrecorded.

Besides this peculiarity, the wild species are remarkable for the variety and beauty of the colours with which the worms are ornamented, as well as by the presence of several longitudinally-disposed rows of semi-horny spines in addition to the dorsal spine on the penultimate segment, as possessed by all the Chinese species.

These natural differences in the two sections of this group are not, however, in my opinion, sufficient to warrant the inference that the wild and the domesticated species belong to different genera, any more than the presence or absence of tails, in the species of the genus *Papilio*, could do so; for we see that in respect to colour, the Chinese worms, when restored to some degree of health, exhibit a very different appearance from that of the worm in its usual sickly state, and that they actually make a near approach to the uncultivated species. Besides which, there are so many traits in the habits, manners, structure and

produce of the two sections that are common to both, that the differences observable can be regarded only as specific and not generic; and although the food of the wild species differs in some instances from that of the domesticated races, yet in every case the trees are found to belong to the same family, and to be closely allied to the mulberry.

I consequently feel inclined to reject the Genus *Theophila*, which Mr. F. Moore (see Trans. Ent. Soc., 3rd Series, i. 315) proposes to establish for the reception of the wild species; more especially since it is very doubtful whether one at least of these could stand under either *Bombyx* or *Theophila*, while as regards *B. subnotata* of Singapore, we know nothing of the larva, and therefore cannot say whether or not it exhibits the spines and other characteristics of the known wild larvæ; and the same may be said of *B. religiosæ*.

It is this eagerness on the part of European systematists to give names to the species contained in the Noah's arks over which they preside, that leads to so much positive confusion as to what is, and what is not, a species,—a remark well illustrated by the late creation of an *Antheræa* under the specific name of *Mezankooria* (see Trans. Ent. Soc., 3rd Series, i. 318), which name is applied in Assam, by the native sericulturists, to distinguish the silk of the Mooga (*Antheræa Assama*), when fed upon the tree called *Addakoory*, from that produced by it when fed upon other trees. A very similar mistake, at which the working naturalist may, without offence, be permitted to smile, was recently made by a French *savant* of some repute, who applied to me for information regarding certain alleged species of Tussur moths, known in India as *Antheræa Teriah*, *Anth. Dabrah*, *Anth. Mooga*, and several more, these being, not the names of insects, but technical terms applied by the native cultivators of Beerbhoom to particular qualities of cocoons of *Antheræa Paphia*, which are assorted according to size, colour, &c., under these various titles.

It would appear that while one school is labouring hard to prove that all organized beings are the descendants of "one primordial type," others are equally bent on proving that each species is *sui generis*, and entitled to stand alone.

7. Bombyx Huttoni, Westw. (Pl. XIX. fig. 4.)

Syn. *Bombyx Huttoni*, Westwood, Cab. Or. Ent. pl. 12, f. 4.
Theophila Huttoni, Moore, Trans. Ent. Soc. Lond., 3rd Series, i. 314, 315.

This species, which feeds on the wild indigenous mulberry tree of the North Western Himalaya, is apparently confined to the

mountains, from the neighbourhood of Dehra, at about 2,000 feet of elevation up to 7,000 and even 8,000 feet. It does not appear to occur in Nipal, but ranges westward from about Kemaon. This worm is double-brooded, and yields two crops of silk in the year; this is of the very best quality, but unfortunately the worm is so erratic and intractable, that hitherto all attempts to domesticate it have proved abortive; it will not remain in the feeding trays, like the Chinese worms, but wanders away until the brood is lost. The only method of rearing it is to leave it at full liberty on the trees, where it remains perfectly quiet and contented, but has so many enemies to contend with, in the shape of birds, flies, bugs and wasps, as to render a crop of silk very precarious and almost unattainable, without constant watching and expense, which renders the crop unprofitable.

As previously stated, I discovered this species at Simla in the autumn of 1837, on the wild forest mulberry, and again after the campaign in Afghanistan, at Mussooree in 1842, at which time I sent it to Mr. Westwood, in England.

The wild mulberry-tree of the North Western Himalaya usually comes into leaf about the first week in March, but of course this is in a great measure dependent upon the situation, elevation and temperature of the season.

The eggs of this silkworm are firmly attached to the bark of the tree, sometimes on the trunk, but more generally on the underside of the branches, where they remain spread out in clusters and exposed all the winter to the action of the frost, but where they are at the same time protected from the rain and snow, so as to run no risk of being washed off by the dissolving of their agglutinating gum.

The colour of the egg is a pale straw-yellow, which, unlike the eggs of the Chinese races, is retained to the last. The egg is considerably larger than those of *B. Mori*. The young worm is disclosed from the egg a few days after the opening of the leaf-buds; the hatching is, however, very irregular and continues sometimes even up to the end of April, although this is generally dependent upon the situation of the tree.

In some seasons these worms are so numerous that the trees are completely denuded of every leaf by the middle of May, and in such cases the worms, after gnawing off all the leaves which envelope the cocoons already formed, are compelled to descend from the tree and spin among the leaves of the neighbouring shrubs and bushes, while many that are still immature necessarily die of hunger, or fall a prey to birds. The trees that have been thus denuded speedily put forth fresh leaves, to be in due time consumed

by the autumnal brood. Trees thus stripped in the middle of May will be again in full foliage by the end of the first week in June.

It is curious to observe the instinctive knowledge which these worms appear to possess of the approach of a hail-storm; no sooner are the peals of thunder heard, than the whole brood seems to regard them as a warning trumpet-call, and all are instantly in motion seeking shelter beneath the thicker branches, and even descending the trunk of the tree to some little distance, but never proceeding so low down as to lose the protecting shelter of the boughs. For rain they care nothing, but appear to be able to distinguish between the coming of a heavy shower, and the more pitiless pelting of the hail.

When the caterpillar is newly hatched its appearance, as seen under a good lens, is as follows:—Head and pro-legs shining jet black; body dark brown, approaching to black; the first segment whitish-ash, the fourth pale rufous, as are the anal feet; tubercles disposed in longitudinal rows, giving forth short tufts of hair; a small anal tubercle on the penultimate segment: thus far there is scarcely a difference between it and the young Chinese worm. Length fully $\frac{1}{8}$ of an inch: strong and robust, as compared with the best domestic stock. In the course of a day or two, the four anterior segments become greatly swollen and of a faint livid cream-colour, the dorsal portion being mottled or dotted with deep brown; the orange or rufous colour of the fourth segment somewhat deeper.

About the fourth day the four anterior segments become swollen up very remarkably into a globular form, the dark spots being apparently beneath the skin; the rest of the body dark brown, with here and there a tinge of dull yellowish. On the fifth day they prepared to moult. After the first moult, the second and third segments form a globular ball, apparently out of all proportion to the rest of the body; the general ground colour becomes creamy-white, with the fourth segment yellow, the second and third being dotted above with dull leaden-grey; the remainder closely marbled over, or variegated without any definite arrangement, with black, grey, orange, ash and yellow blending like tortoise-shell; the fleshy tubercles or spines short, conical and brown; skin smooth.

In the subsequent stages the general appearance remains the same, except that the spines are long and taper to a point, being fleshy at the base, but becoming somewhat horny towards the summits; all bend backwards in a curve except the central one on the penultimate segment, which lies down horizontally and points forward.

When mature the ground colour becomes yellowish-white beautifully and closely marbled over with orange, dark ash-grey, leaden blue and brown; the second and third segments swollen into a large globose mass; the anterior segment creamy-yellow, which colour extends backwards on each side in a broad band through the sixth segment. This resembles the ashy band apparent in the worm of *B. Mori*, after reversion to its natural dark hue. There are two dorsal rows of long, black, slender and sharp-pointed spines commencing with the fifth segment, their base being orange-brown, and the four anterior segments being without them, as in *Attacus Atlas;* on the anal shield are four somewhat conical orange-brown rudimentary tubercles, and rows of small ones along the sides; the dorsal portion of the four anterior segments clouded or blotched with dull leaden-grey markings, apparently showing from beneath the skin; on the third segment are two brown spots or ocelli, marked within with several minute irregular dots of bluish-white; on the front of the second segment are two similar round spots, having a narrow edge and central dot of bluish-white; there are likewise several black spots both before and behind these ocelli; on the fifth segment are two irregular-shaped jet-black spots dotted with bluish-white, and from the centre of these springs the first pair of dorsal spines, which are altogether black: head mottled brown and grey.

It is, however, almost impossible accurately and minutely to describe the distribution and blending of the various colours with which the insect is ornamented.

The cocoon is spun within the leaf from the beginning of May to the end of that month, according to the time of hatching, but I have sometimes taken cocoons as early as the 15th of April and again in September.

The figure of the moth, as represented on pl. 12 of Westwood's Cabinet of Oriental Entomology, is, in several respects, very faulty, owing to the specimen sent to him having been injured during its long journey.

Expanse of wing in the male $1\frac{3}{4}$ inch; of females in general $2\frac{3}{10}$ inches. A black transverse band crosses the upper part of the abdomen at the waist, the posterior edge of which is bordered by a narrow line of ash; on the reflected abdominal margin of the hinder wings are two white spots; all the markings on the wings are of the same character as those upon the wings of *B. Mori*, but are far better defined and more intense than those in Westwood's figure. On the hinder wings the sub-marginal line is ash-coloured, as is also that on the upper wing. The plumes of

the antennæ are likewise much longer than in the figure, which, taking it all in all, is very inaccurate.

In order if possible to reclaim this species and reduce it to a state of domestication, I succeeded in 1859 in obtaining a reciprocal cross between it and the Cashmere worm. In this experiment the female wild moth was coupled with the male *B. Mori*, and the female *B. Mori* with the male *B. Huttoni;* the coupling of the latter was effected with the greatest difficulty, and the few eggs obtained were all unprolific; this always proved to be the case in repeated trials. With regard to the other attempt, the difficulty was not so great, the domestic males eagerly sought the wild females; the latter, however, exhibited an unmistakable dislike of such pigmy sweethearts, though a few coupled and deposited eggs. Still very few of these were prolific, and the caterpillars produced from them retained all the intractable habits of the wild stock, and were accordingly placed upon the trees, where in due time they spun their cocoons. But neither in the caterpillar nor in the cocoon was there any perceptible difference from the wild race, and although some of these females were again crossed by hybrid males, the progeny was still to all intents and purposes as decidedly *B. Huttoni* as at first.

From the refusal of the wild males to couple, and from the great difficulty experienced in inducing the females to allow the domestic males to approach, it may be said that a generic division would be justifiable; yet a certain coupling did take place and the progeny was fertile, although the strength and health of the wild race completely outweighed the influence of the degenerated domestic stock.

It was with a view to the eventual cultivation of the silk of this species that, after a lengthened correspondence, the Government of India in 1858 consented to the formation of a mulberry plantation at Mussooree under my superintendence, but having fully satisfied myself in the course of the second year, that from the intractable nature of the worm it would be impossible to domesticate it, the Government was only too glad to foreclose the experiment, while I having purchased the only tract of land suitable and available for the experiment, was left to "pay the piper" on the plea that the purchase had never been ordered!

8. Bombyx Bengalensis, Hutton.

The Wild Bengal Silkworm. (Pl. XIX. fig. 5.)

This species has apparently become exceedingly rare, if not extinct, in the neighbourhood of Calcutta, where it feeds on the

Artocarpus lacoocha, and was discovered some years ago by the late W. Frith, Esq., of Calcutta, who showed me specimens of the moth in 1849, but stated that the worm fed on the mulberry tree and was not uncommon about Moorshedabad. The moth, however, which he then showed me was totally unlike one presented by Mr. A. Grote, being larger and of a brown colour. Can there be an undescribed species at Moorshedabad?

Of *B. Bengalensis* I have never been able to procure the eggs, although Mr. Grote has interested himself in the matter; he now reports that for the last year or two the species has disappeared. It is probable, however, that it might still be procurable in other parts of Bengal where the bread-fruit tree flourishes. From a well-executed coloured drawing of the larva, furnished through the kindness of this gentleman, I am enabled to record its appearance as follows:—Head brown; from the head to the middle of the sixth segment ashy white or cream colour; the second and third segments wrinkled and slightly intumescent, bearing a few small rufous spots; prolegs rufous brown, with blackish tips; from the middle of the sixth segment to the anal feet pale rufous-brown, each segment dotted with black; stigmata oval white rings, with a black centre; on the dorsal portion of the fifth segment are two slightly raised round black spots, from the centre of which radiate narrow white stripes, and from which rise the first or anterior pair of dorsal spines, which are wholly black; on the eighth segment are two similar spots of a rufous-red colour with white rays, and bearing two black spines; all the other segments bear black dorsal spines, with rufous bases; the spine on the centre of the penultimate segment very large and strong, thick at the base or lower half, and becoming suddenly attenuated and falcate, pointing backwards, the tip only black, the rest pale rufous; the dorsal spines are represented as standing erect. Legs rufous-brown, each bearing a pointed whitish stripe down its centre. The four anterior segments smooth and without spines. In point of size it appears to be far inferior to the larva of *B. Huttoni;* the four anterior segments make no approach to the globular mass which characterises that part in the Himalayan species, neither does it at all resemble it in the colouring.

The moth as furnished by Mr. Grote is of an ashy-white, and the cocoon that of a true *Bombyx*.

9. Bombyx subnotata, Walker.

Syn. *Bombyx subnotata*, Walker, Proc. Linn. Soc. Lond. iii. Zool. p. 188 (1859).

Of this species nothing more appears to be known than is contained in Mr. Walker's description of the moth (*ubi supra*), and that it was procured from Singapore by Mr. A. R. Wallace; neither the larva nor its food are mentioned.

In the absence of all information regarding the caterpillar, whether it is spined, like the two preceding, or smooth, as in the Chinese stock, it is impossible to decide upon the propriety of placing this species in the proposed new genus *Theophila*.

10. Bombyx Horsfieldi, Moore.

Syn. *Bombyx Horsfieldi*, Moore, Cat. Ind. Mus. ii. pl. xi. a, fig. 5.

This is not a Continental species and is merely inserted here to complete the series; the moth is described and figured in the Catalogue of the India Museum, but here again we know nothing of the larva, cocoon or food.

Its habitat is Java.

11. Bombyx Sherwilli, Moore, MS.

Syn. *Bombyx Sherwilli*, Moore, *in epistolâ*.

Of this again the larva is unknown, and indeed the habitat is doubtful too. According to Mr. F. Moore the specimen was obtained from a collection said to have been made in the S. E. Himalayas by the late Major J. L. Sherwill; but Entomologists who have long collected in that quarter assure me that they have never seen a specimen of *Bombyx* from thence. Nevertheless, this is but negative evidence; and if once a specimen has been obtained others may probably follow. According to Mr. Moore it is "allied to *B. Huttoni*, and differs from it in being somewhat larger, and of a greyer colour, the forewing having the apical patch fuliginous instead of black, and it has only a single transverse discal streak (instead of the two, as in *B. Huttoni*). A most prominent character is that the abdomen is tipt with black, as well as having the dark ashy waistband."

Large light-coloured specimens are sometimes seen of *B. Huttoni*, but I do not remember ever to have seen the abdomen tipt with black.

12. Bombyx religiosæ, Helfer.

Syn. *Bombyx religiosæ*, Helfer, J. A. S. Beng. vi. p. 41.
Bombyx Huttoni, apud Moore, Cat. Ind. Mus.
The Joree Silkworm Moth, Helfer.
The Deo-mooga Silkworm, Hugon, J. A. S. Beng. vi. pp. 32, 41.

Habitat Assam, Sylhet.

Of this species, notwithstanding the number of years that have elapsed since its discovery, and my repeated efforts to obtain it through the assistance of gentlemen resident in Assam, nothing more appears to be known than what Dr. Helfer recorded in 1837. It is said to be somewhat rare, but this I suspect is rather to be attributed to the want of research than to any actual scarcity, since the insect appears to have been in considerable abundance on the trees at the time when its discovery was made.

The larva of *B. religiosæ* is said to feed on the leaves of the Peepul tree or *Ficus religiosa*, and for want of more recent information I must content myself with the account furnished by Dr. Helfer (*ubi sup.*), calling attention to the fact of the worm bearing two names,—"*The Joree*" and "*The Deo-mooga*" silkworm, whence, together with one or two other circumstances to be pointed out, I am inclined to think there are two species united under this name, and that neither of them belongs to the genus *Bombyx*.

It is to be observed that the species was discovered in Cachar by Mr. Hugon in 1834, and he describes the worm as being active, *very slender in proportion to its length*, scarcely 2½ inches long, of a reddish colour, and glazed, or shining. The moth, he says, is "very much like that of the mulberry; so is the cocoon also in appearance, colour and size."

Now in describing the worm there is not the least allusion to the slender semi-horny spines which are so remarkable both in *B. Huttoni* and *B. Bengalensis*, while the slender glazed form is again unlike those species, and seems to approach more closely to the genus *Ocinara*.

In regard to the cocoon, while Mr. Hugon declares it to be very like that of the mulberry worm, "in appearance, colour and size," Dr. Helfer, on the other hand, declares it to be "very different from the cocoon of the mulberry moth."

It is to be remembered, however, that Mr. Hugon spoke of an insect which he discovered in Cachar, while Dr. Helfer describes one discovered by Major Jenkins in Assam, where "it yields a

silk, if not superior, yet certainly equal, to that of *B. Mori*, [? *B. textor*, or *B. Crœsi*, probably]. The cocoon shows the finest filament, and has very much silky lustre. It is exceedingly smooth to the touch, and very different from the cocoon of the mulberry moth. The worm lives on the Pipul tree (*Ficus religiosa*)."

It seems to have been entirely overlooked that Mr. Hugon in Cachar found his worms on "the Bur-tree (*Ficus Indica*)," and that "in appearance, colour and size," they were very like the mulberry worm; while Major Jenkins in Assam found his on an allied, but still a different tree, "the Pipul (*Ficus religiosa*)," and the cocoon was "very different from that of the mulberry moth." Is it not quite possible that there may be two distinct species, the Deo-mooga of Cachar, and the Joree of Assam?

What renders the uncertainty still greater is the fact that Mr. Hugon himself "was unable to determine whether the Joree and Deo-mooga were the same, and was inclined, from the colour of the cocoons and the slight observations he was able to make on the latter, to think them distinct." My own opinion, judging from what has been advanced, and from the fact that the cocoons are said to be less even than those of the *Dasee* (*B. fortunatus*), is, that neither the one nor the other belongs to *Bombyx*, but will be found to be species of the allied genus *Ocinara*, an opinion supported in some measure by the nature of the food, these insects feeding on two species of *Ficus*, just as our two mountain species at Mussooree are confined to the *Ficus venosa*.

Genus Ocinara, Walker.

The insects of this genus, although in some respects allied to *Bombyx*, show likewise in the larva state a strong approach to the *Geometræ*, being characterized by knotty and dry bud-like excrescences, which, with the rigid attitude assumed when at rest, give the insect the appearance of a withered twig or piece of dry stick. In those discovered at Mussooree the larvæ appear to be almost entirely night-feeders, seldom moving during the day from the position they have taken up, which is usually at the end of a thin twig, along which they lie stretched out immovable, and to which they are so much assimilated, both in colour and ruggedness of appearance, as easily to pass unnoticed.

1. Ocinara Moorei, Hutton.

The larva of this species feeds on the *Ficus venosa*, and is found at Mussooree at an elevation of about 5,400 feet; it spins a small

white silken cocoon on the inner surface of the leaf, or even, should it fall from the tree, under a tile or stone, or against a flower-pot. There are certainly two broods during the summer months, and I suspect as many as three or four.

The larva is of an earthy-brown colour, and covered with short hairs; it has a raised transverse ridge across the second segment, in front of which is a blackish patch; it has a very short truncated spine on the middle of the penultimate segment, which usually lies down pointing backwards, and even with the plane of the back; it is, however, capable of being raised into an erect position when the insect is disturbed. The general appearance is rough and bark-like, and the ventral line is thickly fringed, as are the feet also, with rather long hairs.

The moth, judging from the description given by Mr. Moore of his species *O. Lida*, appears closely allied to it, and were it not that he makes no mention of the three black spots on the abdominal margin of the lower wings, of a black dot on the disc beneath, and gives palpi ferruginous instead of dusky black, I should have been strongly tempted to consider them as identical.

The wings in both sexes are of a creamy white, partially suffused with a faint ferruginous tinge; an indistinct undulating submarginal line bearing a ferruginous mark on each nervure, the largest being on the costal margin; abdominal and outer edges of the wings well fringed with long cilia, forming a well-marked border; an indistinct sub-basal wavy line with one or two indistinct ferruginous dots on the nervures; on the hinder wing is a wavy, very indistinct pale-brown band at about one-third from the margin; the fringe of the lower wings terminates in a projecting square patch, caused by the turning down or folding of the remaining portion of the abdominal margin, on which are three ferruginous dots. Body tricarinated, or having a dorsal and a lateral line on each side composed of tufts of long scales of a triangular form, and appearing like a projecting serrated line; colour very faint ferruginous, or sandy brown, very little darker than the wings. Antennæ bipectinated and faintly tinged with ferruginous; thorax, and forehead between the eyes, white; eyes, palpi, and inner side of forelegs, dusky black; under side ashy white, the wavy brown bands and spots well defined, and there is a black dot on the disc of the lower wings; body beneath whitish. Expanse of wing in the male $1\frac{1}{2}$ inch, in the female 2 inches.

The silk of this species is fine and elastic; the cocoon oval, flattened beneath where in contact with the leaf, convex above; it is enveloped in a light screen of floss silk, spread over it in

curls, and not web-like as in *Bombyx*. The cocoon is too small to become valuable. I have taken cocoons both in May and in August. The larva is usually found stretched along a thin branch, to which it clings very closely, and is scarcely distinguishable from the wood.

2. Ocinara lactea, Hutton. (Pl. XIX. fig. 6.)

The larva of this species feeds likewise upon the *Ficus venosa*, at the same place and elevation as the last, and is often found with it on the same tree. It appears to be a far more abundant species than the former, and is usually found stretched along the extreme end of a twig, and so close that it appears to be part and parcel of the branch; at other times it will be found obliquely erect and stiff so as to resemble a dry stick. When very young it resorts also to the edges and back of the leaf. It is without hairs, and quite naked. The young worm is of a pale-yellowish green, resembling the leaf-stalk upon which it rests; on the back of the second segment is a slightly raised transverse ridge tinged with brown, and on the fifth and ninth segments are two slightly-raised round tubercles of the same colour; an anal horn, on the penultimate segment, which is also light brown. When adult, the colour changes to a russet brown like the bark of the tree, and the transverse ridge and tubercles become well developed and somewhat darker than the rest of the body; the anal horn or spine generally appears as if truncated by the loss of the summit, —yet such is not the case, as the extremity is retractile, and is generally withdrawn into the lower part as a sheath; when the animal is about to moult, or is disturbed and irritated, the summit of this spine is exserted, and instead of being brown, like the base, is whitish; when exserted the whole stands erect, slightly inclining backwards. It would be a difficult task to explain the use of this curious contrivance, and I have been hitherto unable to detect anything that could lead me even to conjecture what purpose it can possibly serve.

The shape of the larva is similar to that of *O. dilectula*, as figured in the second volume of the Lepidopterous Insects in the India Museum, except that in the figure of the latter there are no raised tubercles.

From the larva of the preceding species it differs both in shape and habits. In *O. lactea* the entire form and appearance are those of a *Geometra*, but it nevertheless progresses in the usual way like the larva of *Bombyx*. In its manner of stretching from the twig to an adjacent leaf while feeding, and in its habit, when at rest,

of folding the prolegs together and obliquely raising all the anterior segments of the body, as far back as the sixth, off the surface of the twig or leaf, and at an acute angle with the plane upon which it stands, it very strongly resembles a *Geometra*, and gives one the idea of its forming a connecting link between that curious genus and the *Bombyces*. It feeds principally at night like the last, and in its younger stages is usually found at the extreme end of a young leafy twig, the terminal bud of which it strongly resembles. It spins a small compact cocoon, shaped like that of the last, but of a sulphur-yellow colour instead of white, and the flossy web which covers it is more closely woven into a kind of network, with regular open circular meshes. The eggs are at first of a very pale straw yellow, and are deposited in short lines of three to eight in each; after a time a red dot appears in the centre of the egg, and then, in a day or two more, the entire egg changes to a dark stone-grey, and the young worm speedily emerges.

The moth is small and white, often with the wings partially hyaline and iridescent, though this, I am inclined to think, arises from the abrasion of the scales, which are very loose and easily rubbed off. The upper wing has an indistinct and nearly obsolete submarginal and slightly undulating double line, with a minute black dot on each nervure, and a larger one on the costal margin flanked on each side by a smaller one. About the middle of the costal margin, at a little distance within the wing, is a black spot formed by two short parallel lines close together, and an almost obsolete double-curved line near the basal angle, running from the anterior to the posterior margin; both the wings are rounded externally. The lower wing has also an obscure brownish submarginal line without dots; a small black dot on the disc, which however is not always present, and three well-defined black spots on the fringe of the abdominal margin, which, as in the foregoing species, is folded down. The under-side is dull white, with the discal spots and submarginal lines more clearly developed than above. Eyes and palpi black; antennæ with white shafts and ferruginous plumes: body densely clothed with long hair-like scales; upper surface of body smoky ash-grey; thorax and forehead between the eyes white.

Throughout July and August the larvæ of this species are abundant at an elevation of 5,400 feet on the *Ficus venosa*, which the natives term "*Doodli*," from the milky nature of its juices which exude freely when a leaf is plucked. In the female of this moth

there is a dorsal keel, serrated, and composed of long scales. Expanse of female $1\frac{6}{10}$ inch, of male $1\frac{3}{10}$ inch.

3. Ocinara Comma, Hutton.

This occurs in the Dehra Doon at the foot of the mountains, where the moth is said to be usually found on the Mango tree, but it has not yet been ascertained whether the larva feeds upon its leaves or not.

The moth is white, both in wings and body, with a single comma-like black mark about the centre of the anterior margin of the upper wing and at a little distance from the margin; underside also white, with the comma mark a little less distinct, and on the centre of the hinder wing is a very faint indication of a black spot; antennæ bipectinate, the shaft white, with faint ferruginous plumes; the face and palpi dull yellowish; the two anterior pairs of legs each bearing two black spots on the outer edge; expanse of wing in a female $1\frac{9}{10}$ inch.

Appears in July and August.

Besides these, I am informed that other Continental species have been captured at Darjiling, but to these at present I have no access.

There are likewise two species from Java, noticed by Mr. Moore in the second volume of the Lepidoptera contained in the India Museum. These are—

4. Ocinara dilectula, Walker.

Syn. *Ocinara dilectula*, Walker, List Lep. Het. Brit. Mus. pt. vii. p. 1768(1856); Moore, Catal. Lep. Ind. Mus. ii. p. 381.

Habitat Java, where procured by the late Dr. Horsfield. Like the species at Mussooree it is said to "feed upon a species of *Ficus*, bearing the native name of *Weringin*." This circumstance seems to point out the species of *Ficus* as the natural food of the genus, and makes me still more inclined to regard the *Bombyx religiosæ* as belonging in reality to *Ocinara*.

5. Ocinara Lida, Moore.

Syn. *Ocinara Lida*, Moore, Cat. Lep. Ind. Mus. ii. p. 381.

This is likewise a Javanese species discovered by Dr. Horsfield, but nothing is recorded of the larva or its food. The moth is described in the above-named publication, and appears to be closely allied to my *O. Moorei*.

Genus Trilocha, Moore.

1. Trilocha varians, Moore. (Pl. XIX. fig. 1 ♂, fig. 2 ♀.)

Syn. *Trilocha varians*, Moore, Cat. Lep. Ind. Mus. ii. p. 382.
Naprepa varians, Walker, List Lep. Het. Brit. Mus. pt. v. p. 1153 (1855).

This species, which is figured in vol. ii. of the Catalogue of Lepidoptera in the India Museum, is said to have been presented by J. N. Ward, Esq., from Canara, but nothing more is recorded; the figure given by Mr. Moore (*ubi sup.*) looks wonderfully like an *Ocinara*.

Note.—The larvæ here figured (Pl. XIX. figs. 1, 2), which I believe to be those of the male and female (the moths of both being also figured in the original drawings from which these are copied) were discovered in the neighbourhood of Calcutta, by Mr. A. Grote, by whom they were kindly forwarded to me. They were found in February and March, feeding on *Trophis aspera*, other larvæ being also taken on *Ficus indica* and *F. religiosa*. Spins a small yellowish-white cocoon, within the leaf or naked. Drawings of the same insect in all its stages were made by Mr. Walter Elliot during his residence in Madras, the larvæ there also being found on *Ficus religiosa*.—F. Moore, February, 1865.

DESCRIPTION OF PLATE XIX.

Fig. 1. Larva of *Trilocha varians*, ♂.
2. ,, ,, ,, ♀.
3. ,, *Bombyx fortunatus*.
4. ,, *Bombyx Huttoni*.
5. ,, *Bombyx Bengalensis*.
6. ,, *Ocinara lactea*.
7. ,, *Bombyx Mori*, reverted.
8. ,, ,, ,, as cultivated.